



# Demographic Influences on Drought Coping Strategies among Pastoralists in Kirisia Watershed, Samburu County, Kenya

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## Abstract

Meteorological drought poses significant challenges to pastoral households in Kenyan Arid and Semi-Arid Lands, yet remains understudied. This study examined pastoral household coping strategies and their demographic associations in response to meteorological drought in Kirisia watershed, Samburu County. Using purposive sampling, 70 pastoral households were surveyed to identify drought coping strategies and analyze associations with demographic characteristics. Results revealed that relief assistance was the most prevalent coping strategy (25.71%), followed by livestock migration (24.29%), fodder purchasing and household migration (15.71% each). Economic diversification strategies, including business engagement (8.58%) and urban employment migration (7.14%), showed limited adoption. There were demonstrably significant associations between demographic factors and strategy selection, with marital status influencing fodder purchasing and business engagement, while age and education strongly predicted household migration and entrepreneurial activities. Pastoral households perceived worsening drought conditions, with extended droughts being the primary concern, alongside increasing frequency and shifting patterns. The study findings indicate growing external aid dependency as traditional coping mechanisms become inadequate under increasingly erratic drought patterns. Limited formal educational attainment and smaller household sizes constrain adaptive capacity and drought resilience. The study highlights the need for targeted interventions that address demographic barriers while strengthening sustainable drought adaptation strategies in pastoral systems.

## Subject Areas

Climate Variability, Pastoralism

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## Keywords

Meteorological Drought, Pastoral Households, Coping Strategies, Kirisia Watershed

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## 1. Introduction

Meteorological drought, defined as a prolonged period of below-average rainfall in a specific geographic region [1], occurs with greater frequency in Arid and Semi-Arid Lands (ASALs), where it often negatively affects household livelihoods [2]. Nearly 80% of the landmass of Kenya is classified as ASAL [3], and in these regions, rainfall is the primary driver of both agricultural and pastoral livelihoods [4]. Pastoralism is common in areas of low agricultural productivity because it integrates mobility [5], a vital coping strategy in the face of natural resource variability, and requires relatively low external inputs [6]. However, pastoralism is highly dependent on rain-fed vegetation and water availability, and thus pastoral households remain particularly vulnerable to meteorological drought. This vulnerability is further exacerbated by increasing water demand, driven by growing human and livestock populations [4], household-level maladaptation to drought [7], and weak institutional support for pastoralist systems [5].

In Africa, meteorological drought remains a critical but an understudied threat. More than 80% of livelihoods on the continent depend on rainfall [8]. At the same time, 85% of drought research in Africa is focused on agricultural drought, *i.e.* prolonged-below-mean soil moisture deficit, which affects a growing season, with only 25% of studies addressing meteorological, hydrological, or socio-economic drought dimensions [9]. This imbalance has impeded improved understanding of how meteorological drought affects African communities, particularly pastoral households.

East African pastoralists adopt diverse drought coping strategies—including herd mobility, livestock diversification, fodder storage, and non-livestock income activities—with their choices often shaped by institutional support, land access, and local migration opportunities rather than climate factors alone [10]. Further, poorly managed interventions may unintentionally reduce adaptive capacity in ASALs by disrupting mobility and local resource-sharing norms [11]. Coping is context-specific and influenced by both environmental and socio-economic constraints [8].

Recent rainfall patterns in the East African region are characterized as erratic and declining [12], and as a consequence, more frequent and severe meteorological droughts. According to the Intergovernmental Panel on Climate Change (IPCC) [13], drought frequency is projected to increase in frequency and severity, with profound socio-economic and ecological impacts. Consequently, traditional drought coping strategies in rainfall-dependent livelihood systems like pastoralism are becoming increasingly ineffective as climatic patterns shift [14].

Kenya is considered a drought vulnerable nation [15]. Studies indicate that drought occurrence has intensified significantly, shifting from decadal events in the 1970s to cycles of every 2 - 3 years from the 1990s onward, with increasingly unpredictable patterns in recent decades [16] [17]. The Kenyan government declared eight national drought emergencies between 1992 and 2023 [18]. The ASALs in the country, which support 35% of the national human population and 70% of livestock, experience the most severe drought impacts [18]. In these regions, meteorological drought directly influences livelihood patterns and pastoralism is dominant [19]. While pastoralists have historically developed drought adaptation mechanisms, some strategies have proven counterproductive. Land use changes, including excessive resource extraction and forest encroachment, have intensified negative impacts during subsequent drought periods [20].

Kirisia watershed, a drought haven for pastoral households, is facing mounting stress from expanding human and livestock populations, creating heightened demand for water and vegetation resources [4] [21]. At the same time, climate variability in the watershed is escalating, altering drought patterns and threatening both community livelihoods and ecosystem stability [20]. These issues compound the impacts of future droughts, diminishing resilience for both ecosystems and local communities. Despite these trends, there is limited empirical research examining how pastoral households in Kirisia respond to meteorological drought or how household demographic factors influence the choice of coping strategies. Addressing this gap, the study seeks to answer the questions: What are the pastoral household coping strategies in response to changes during meteorological drought in Kirisia Watershed? And is there an association between pastoral household demographic characteristics and their choice of drought coping strategies in Kirisia watershed?

## 2. Methodology

### 2.1. Study Area

The Kirisia watershed, in **Figure 1** (0° 40'N - 2° 50'N, 36° 20'E - 38° 10'E), is located in Northern Kenya between the altitudes 1273 m to 2625 m within ecological zones IV - VI [22], encompassing 15 rivers that feed the Ewaso Nyiro North watershed [20] [23]. The area receives 600 - 750 mm annual rainfall with temperatures of 24°C - 33°C, experiencing dry seasons from January-February and rains from March-May [23] [24]. The watershed supports predominantly Samburu pastoralists alongside other ethnic groups, with communities accessing water sources at distances of 0.5 - 3.5 km [21] [23]. Land management operates under three tenure systems: government-managed Kirisia Forest (Kenya Forest Service), communal group ranches (13 units), and limited private ownership (2%) [25]. The forest serves as critical dry-season grazing and provides resources including honey, medicinal plants, firewood, and construction materials, with community access governed by traditional rules and leadership [20] [25].

### Kirisia Forest Watershed

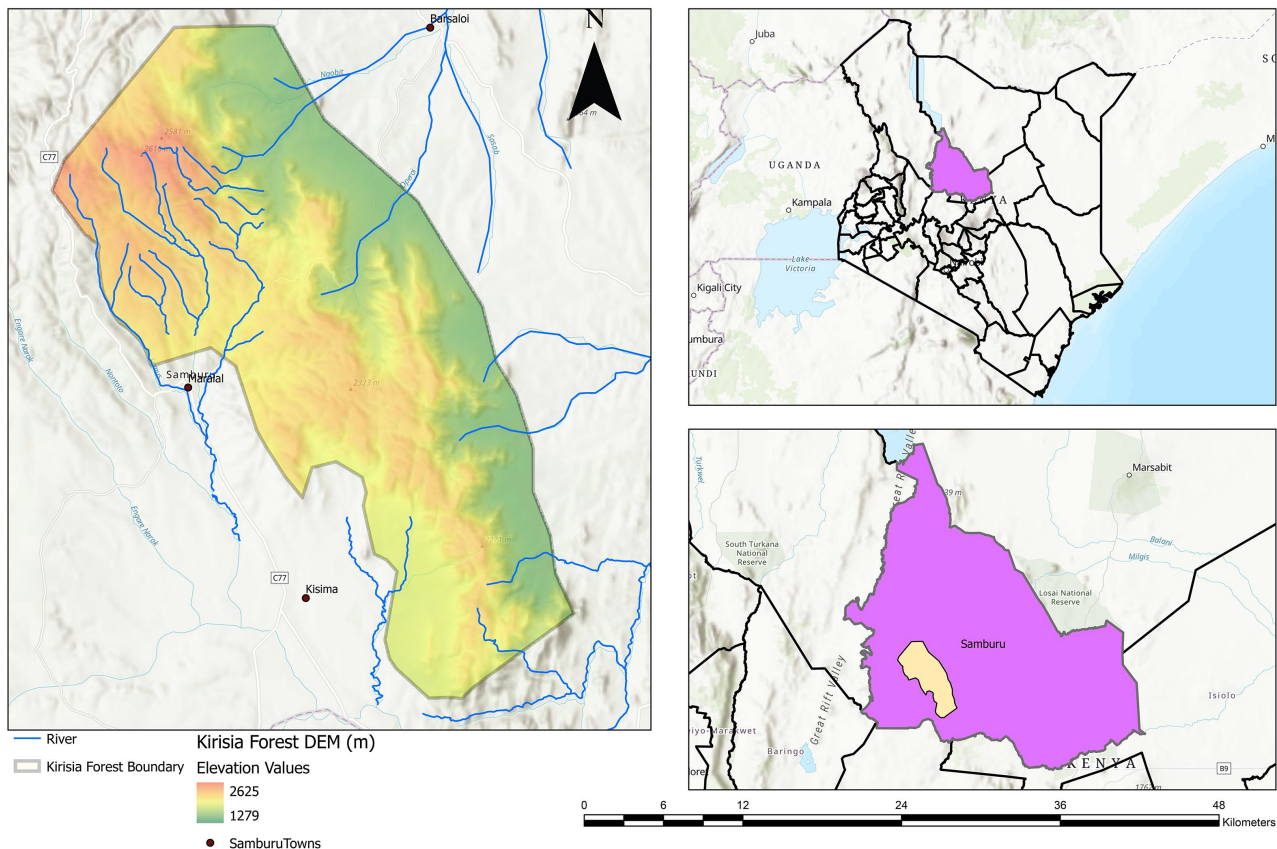


Figure 1. Map of the study area.

### 2.2. Sampling and Sample Size

The study employed purposive sampling, where participants were chosen based on their expertise and direct experience relevant to the research aims [26]. Two Community leaders and two local guides facilitated participant selection, utilizing their indigenous knowledge to identify households with substantial experience in drought adaptation practices. This non-probability approach emphasizes obtaining rich, detailed information rather than statistical representation [26], making it well-suited for research seeking location-specific understanding that may not be generalizable to broader populations. Alternative approaches, such as random sampling, could have inadvertently included non-pastoral households, thereby compromising the scope of the study. However, purposive sampling enables targeted data collection from information-rich respondents, it inherently limits the statistical generalizability of the findings to the broader population.

The sample size was calculated using this formula:

$$n = \frac{Z^2 \times p(1-p)}{e^2} \tag{1}$$

where  $Z$  represents the standard normal deviation at 90% confidence interval,  $p$  denotes the estimated population proportion possessing the target characteristics,

and  $e$  indicates the standard error [27]. This formula was selected due to the absence of precise household population data for the watershed during the research period. The proportion  $p$  was established at 52% based on previous research conducted in the region [20]. The resulting sample comprised 68 participants.

This research utilized Swift's [28] pastoral household definition, requiring livestock production to constitute more than 50% of total household income. Household heads were directly questioned regarding the percentage of income derived from livestock activities to confirm eligibility. Only households satisfying this threshold participated in the study. This selective approach was deliberate to differentiate pastoral households from agro-pastoral systems that integrate livestock management with crop farming for sustenance. Research on pastoral livelihoods frequently combines these distinct household types, resulting in conclusions and broader generalizations that may not accurately represent either group [29].

### 3. Results and Discussion

#### 3.1. Results

##### 3.1.1. Socio-Demographic Characteristics of Respondents

The study examined the socio-demographic characteristics of the respondents, including household head gender, respondent gender (noting that respondents were not always household heads), age, educational attainment, and household composition. These characteristics are detailed in **Table 1** below.

**Table 1.** Socio-demographic characteristics of the respondents.

Socio-demographic Feature	Demographic Characteristics		
	Category	Frequency	Percentage
Sex of Household Head	Male	53	75.71%
	Female	17	24.29%
Gender of Respondent	Male	46	65.71%
	Female	24	34.29%
Age	18 - 24 years	11	15.71%
	25 - 30 years	10	14.29%
	31 - 45 years	33	47.14%
	46 - 60 years	16	22.86%
Education Level	No formal education	27	38.57%
	Primary	28	40.00%
	Secondary	11	15.71%
	Post-secondary	4	5.72%
Household Size	1 - 5 members	50	71.43%
	6 - 10 members	13	18.57%
	More than 10 members	7	10.00%

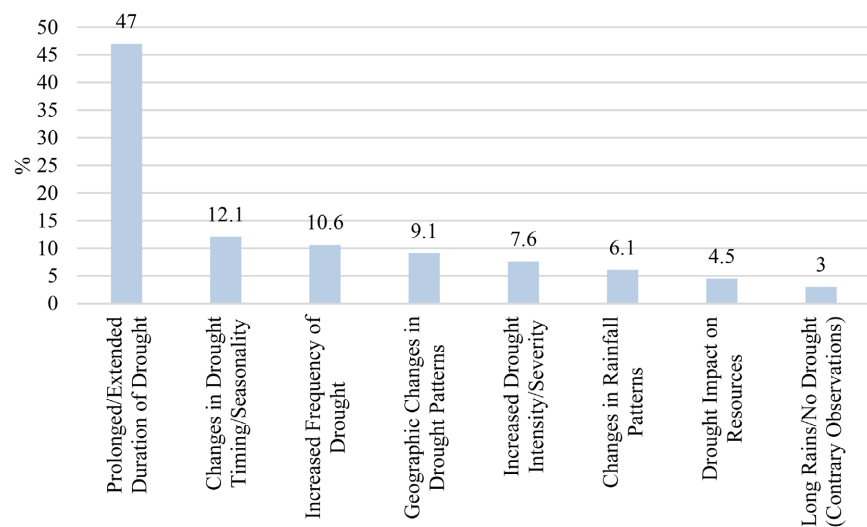
The respondent household head split was 75.71% for male-headed households, while female-headed households (widows, single-parent families, and women serving as household leaders during intermittent male absence) comprised 24.29%. This gender pattern extended to survey participation, where male respondents represented 65.71% of participants compared to 34.29% female respondents.

Age distribution among respondents showed a concentration in middle-age groups, with 47.14% falling between 31 - 45 years, representing the largest demographic segment. Younger adults aged 18 - 30 years constituted 30% of respondents, while those aged 46 - 60 years comprised 22.86% of the sample. Educational attainment levels remained relatively low across the surveyed population, with only 21.43% of respondents having completed post-primary education and a mere 5.72% advancing beyond secondary schooling.

Household composition data indicated that smaller family units predominated in the watershed, with 71.43% of households containing 1 - 5 members. Larger households exceeding 10 members, including hired workers, represented only 10% of the surveyed families, suggesting that most households operate with limited internal labor resources.

### 3.1.2. Perception of Drought among Pastoral Households

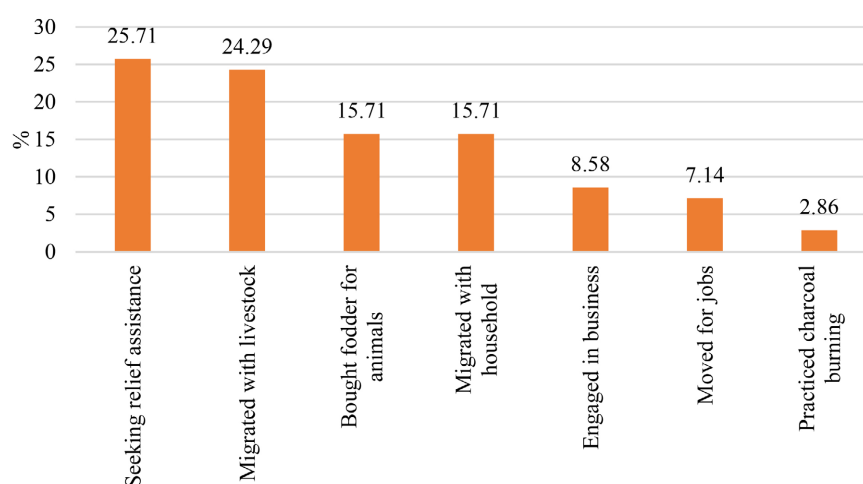
**Figure 2** shows the themes in drought perception of the surveyed households. Drought emerged as the dominant theme among respondents, with extended droughts receiving the highest number of mentions (47%). Additional drought-related subthemes identified included increased drought frequency and shifting drought patterns, alongside changes in drought seasonality. Respondents observed increasing drought severity, indicating a perception of escalating drought impacts on pastoral livelihoods. Some respondents reported periods of extended rains without drought, suggesting some climate variability within the overall drought pattern.



**Figure 2.** Drought perception among pastoral households in Kirisia watershed.

### 3.1.3. Drought Coping Strategies Employed in Kirisia Watershed

The survey identified multiple drought coping strategies (as shown in **Figure 3**) employed by pastoral households in Kirisia Watershed. Relief assistance was reported most frequently at 25.71%. This assistance includes food aid, water delivery, and emergency livestock feed provided by government agencies and NGOs, including the Kenya Red Cross. Livestock migration represented the second most common strategy at 24.29%, followed by two equally reported approaches: purchasing fodder for animals and household migration, each reported by 15.71% of respondents. Economic diversification strategies showed lower adoption rates, with business engagement reported by 8.58% and urban migration for employment by 7.14% of households. Charcoal burning represented the least common strategy at 2.86% of respondents.



**Figure 3.** Drought coping strategies employed in Kirisia watershed.

### 3.1.4. Association between Coping Strategy Employed and Socio-Demographic Features

Statistical analysis revealed significant associations between demographic characteristics and drought coping strategies among pastoral households (**Table 2**). Marital status demonstrated significant relationships with fodder purchasing ( $\chi^2 \approx 7.95$ ,  $p \approx 0.047$ ) and business engagement ( $\chi^2 \approx 7.81$ ,  $p \approx 0.050$ ). Age showed a strong association with household migration ( $\chi^2 \approx 14.29$ ,  $p \approx 0.0025$ ), while formal education level was significantly linked to both household migration ( $\chi^2 \approx 14.51$ ,  $p \approx 0.0023$ ) and business engagement ( $\chi^2 \approx 9.29$ ,  $p \approx 0.026$ ). All relationships demonstrated p-values below 0.05, indicating statistical significance.

**Table 2.** Association between coping strategy employed and household socio-demographic characteristics.

Demographic Feature	Coping Strategy	$\chi^2$	p-value
Marital Status	Bought Fodder	7.953892	0.046974
Marital Status	Engaged Business	7.814841	0.049997

**Continued**

Respondent Age	Migrated Household	14.293134	0.002532
Education Level	Migrated Household	14.507036	0.00229
Education Level	Engaged Business	9.285714	0.025724

Only statistically significant associations are represented in the table above.

**3.2. Discussion**

As the study relied on purposive sampling, the findings—though contextually rich—may not be representative of all households in the region and should be interpreted with caution when applied beyond the study area. The demographic profile of Kirisia watershed households reflects established patterns in pastoral communities, with male-headed households (75.71%) and male survey dominance (65.71%) aligning with regional studies [20] [30]. Cultural norms positioning men as primary resource governance decision-makers explain this gender distribution. The concentration of middle-aged respondents (31 - 45 years, 47.14%) indicates the central role of this demographic in household management, while younger members' involvement reflects their critical function in livestock management during drought periods [31].

Limited educational attainment, with only 21.43% achieving post-primary education, significantly constrains drought adaptation capacity. Education expands socio-economic coping strategies and creates alternative livelihood opportunities [31], making the low educational levels a critical vulnerability. In Kirisia Watershed, education facilitates coping strategies like business engagement and migration at the household level through the enhancement of access to information, knowledge about finance, and social networks beyond traditional pastoral systems. Educated individuals are likely to understand and function within formal markets, have training or support programs, and identify livelihood opportunities beyond livestock livelihoods. Besides, education boosts mobility and adaptability, enabling more youthful or educated household members to seek alternative livelihood sources—e.g. small businesses or urban employment—during drought. This diversification reduces dependence on climate-sensitive livelihood and increases household resilience. The prevalence of smaller households (71.43% with 1 - 5 members) presents additional challenges, as larger households typically provide greater labor resources essential for drought management activities.

Pastoral households perceive worsening drought conditions, with extended droughts being the primary concern. This aligns with the findings of [32] of eroding efficacy of drought coping strategies over time. The emphasis on changing drought frequency and shifting patterns indicates disruption of traditional drought cycles that historically guided coping strategies. These changes undermine established prediction mechanisms that pastoral communities rely upon for drought preparation [33] [34], potentially compromising resilience in both current and future drought events.

The dominance of relief assistance (25.71%)—primarily provided by agencies such as the National Drought Management Authority (NDMA), the Red Cross, and local county government—signals increasing household vulnerability and growing external aid dependency as traditional mechanisms fail under unpredictable drought patterns. While livestock migration remains important (24.29%), it faces mounting constraints from land use changes and tenure issues [35]. The moderate adoption of fodder purchasing and household migration (15.71% each) reflects supplementary strategies with inherent limitations, financial constraints for fodder and social network disruption for migration [36].

Economic diversification strategies show limited uptake, with business engagement (8.58%) and urban employment migration (7.14%) constrained by low educational levels that restrict access to information networks and employment opportunities [31]. Charcoal burning has minimal adoption (2.86%), reflecting legal restrictions in the protected Kirisia Forest and environmental sustainability concerns. The statistical associations between demographics and coping strategies confirm that marital status influences fodder purchasing and business engagement, while age and education strongly predict household migration and entrepreneurial activities, supporting findings that younger, more educated households demonstrate greater adaptive capacity [31].

The findings reveal that while pastoral households employ diverse drought coping strategies, many approaches are becoming less viable due to erratic drought patterns, legal constraints, and socio-economic barriers that limit access to sustainable adaptation alternatives.

## 4. Conclusions and Recommendations

### 4.1. Conclusions

Pastoral households in Kirisia watershed face a complex challenge where traditional coping strategies are becoming less viable while barriers to alternative strategies remain substantial. This situation creates a dependency cycle on external assistance that may ultimately undermine community resilience and self-reliance. The findings show a concerning reliance on external aid dependency, with relief assistance emerging as the dominant coping strategy, a sign that traditional drought coping strategies are under pressure. While pastoral households employ diverse strategies, including livestock migration, fodder purchasing, and household relocation, many approaches face mounting constraints from environmental, legal, and socio-economic barriers.

Demographic analysis reveals significant associations between household characteristics and coping strategy adoption, with education and age serving as key predictors of adaptive capacity. Limited formal educational attainment represents a critical vulnerability that restricts access to economic diversification opportunities, while smaller household sizes have fewer available labor resources for drought management activities. Further, extended drought duration and shifting patterns undermine traditional prediction mechanisms that have historically guided pastoral

household responses.

Other variables such as income level, land size, and access to extension services were acknowledged as potentially important determinants of drought coping strategies. However, collecting accurate data on income and land ownership in pastoral contexts is often challenging due to seasonal mobility, informal land tenure, and reluctance to disclose sensitive financial information. The study therefore focused on readily observable and consistently reportable demographic characteristics such as age, gender, education, and marital status. Future studies may consider incorporating these socio-economic variables to deepen the understanding of household-level adaptation dynamics.

## 4.2. Recommendations

Based on the study findings, the following recommendations are made to address the vulnerabilities identified in pastoral drought coping strategies:

**Establish Targeted Adult Education Programs for Pastoral Communities.** Adult education programs focusing on literacy, numeracy, and entrepreneurial skills should be implemented to enable pastoral households to access alternative livelihood opportunities during drought periods, reducing over-reliance on external relief assistance.

**Develop Community-Managed Fodder Banking Systems.** With fodder purchasing representing a significant coping strategy but facing financial sustainability challenges, establishing community-managed fodder banks would provide affordable livestock feed alternatives during drought periods.

**Strengthen Early Warning Systems Integrating Indigenous and Meteorological Knowledge.** The study findings showed that pastoral households perceive increasingly erratic and unpredictable drought patterns that undermine traditional prediction mechanisms. Early warning systems that combine meteorological data with local indicators would improve drought preparedness and enable more effective timing of coping strategy implementation, potentially reducing the current high dependency on emergency relief assistance.

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## Conflicts of Interest

The authors declare no conflicts of interest.

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